Description

Method for transmitting packet data in a radio telecommunications system

The invention relates to a method for transmitting packet data in a radio telecommunications system in accordance with the precharacterizing clause of claim 1.

Radio telecommunications systems are known whereby a time-slot separation method (time-division multiplex) is used for separating users during radio transmission. With such radio telecommunications systems, for example operating in accordance with the Digital Enhanced Cordless Telecommunication standard, it can be advantageous because of the limited transmission capacity to dynamically allocate an available bandwidth to the individual generally mobile user stations (radio transmitters and radio receivers). In these systems, collisions can occur during the transmission of data packets. These occur, for example, if an Automatic Repeat Request (ARQ) method is used in accordance with a transmission protocol, because the transmission of individual data packets is repeated as part of this ARQ procedure, if a confirmation, i.e. a positive acknowledgement (ACK) of the receipt of a packet is absent and the existing resources thus become exhausted after a certain number of such repeat requests.

The object of the invention is to provide a method that reduces the mutual interference between radio transmitters and radio receivers of a radio telecommunications system.

This object is achieved on the basis of the method defined in the precharacterizing clause of claim 1 by the features specified in the characterizing part of claim 1.

With a method in accordance with the invention for transmitting packet data in a radio telecommunications system comprising a plurality of radio transmitters and radio receivers that use a dynamic multiple access method for separating users at least by means of a time-slot separation method, in particular a Time Division Multiple Access (TDMA) method in addition to methods for secure data transmission, particularly an Automatic Repeat Request (ARQ) method, whereby if a renewed transmission of a data packet is required, a repeat time slot is inserted and frequencies are allocated to radio transmitters and radio receivers in such a way that each transmitter or receiver is allocated a unique identifying frequency, whereby a frequency slot separation method can be implemented for the duration of the repeat time-slot in such a way that a data packet to be repeated, which is destined for a radio transmitter or radio receiver, is transmitted on the frequency identifying said transmitter or receiver and whereby in each radio transmitter or radio receiver a frequency is selected in such a way that said transmitters or receivers search for a repeated data packet on their respective identifying frequency.

By means of the method in accordance with the invention, it is possible to use a positive ACK in the transmission protocol in radio telecommunications systems that use a time-slot separation method. This is achieved mainly in that a frequency-slot separation method is used during the repeat time slot, so that even if several radio transmitters or radio receivers initiate a repeat transmission of data packets, no mutual blocking takes place. The method is also characterized by the

fact that it is easy to implement, particularly in radio telecommunications systems that operate according to the DECT or WDCT standard.

In an advantageous further development, an allocation of frequencies to radio transmitters/receivers is carried out in such a way that each radio transmitter/radio receiver is allocated, once only, a unique identifying frequency, particularly as part of an initialization of the radio coverage area, with the allocation being stored, at least temporarily, in the radio transmitters and radio receivers. This has the advantage that there is no charge for the resources of the radio telecommunications system due to this allocation step, but instead a radio transmitter/radio receiver in the following needs to access the stored allocation only if required.

Alternatively, it is, however, also advantageous if this allocation step is carried out at the start of each transmission frame in accordance with the time-slot separation method. In this way, it is possible to keep the radio transmitters and radio receivers in the most up-to-date status, so that flexible reaction is possible, for example if there are fluctuations in the overall number of radio transmitters and radio receivers.

As an alternative or supplement, it is advantageous to arrange for the allocation of frequencies to radio transmitters and radio receivers to be performed in such a way that each radio transmitter/radio receiver is assigned a sequence with an unambiguous starting value. This enables simple implementation, particularly in radio communications systems that operate in accordance with the WDCT standard.

If the steps are then carried out whereby a frequency-slot separation method can be implemented for the duration of the repeat time-slot in such a way that a data packet to be repeated that is destined for a radio transmitter or radio receiver is transmitted on the frequency identifying said transmitter or receiver and in each radio transmitter or receiver a frequency can be selected in such a way that said transmitters or receivers search for a repeated data packet on their respective identifying frequency, then if in a radio coverage area of the radio telecommunications system it is determined before the start of a transmission frame that a first number of radio transmitters and radio receivers in a radio coverage area exceeds a second number of repeat time-slots available in the radio coverage area in accordance with the time-slot separation method, energy resources are saved because the steps of the method are therefore only carried out if there is an actual danger of blocking the repeat time slots.

Alternatively, it is advantageous if these steps are carried out for each repeat time-slot. In this case, a determination of the radio transmitters and radio receivers in the radio coverage area is superfluous, thus resulting in a simple realization of the method in accordance with the invention that is easy to implement. This development can however also be used additionally for the detection of radio transmitters and radio receivers and is advantageous because detection and particularly the signaling of the result can be minimized. This can be achieved if, for example, after the first number has exceeded the second number for the first time, further signaling of the detection results is withheld until the first number has reached, or fallen below, the level of the second number.

Advantageously, a repeat takes place due to the absence of an acknowledge message from a receiving radio transmitter/radio receiver. In this way, the reception of a fault-free packet is acknowledged by a positive ACK. With this procedure, the method in accordance with the invention realizes its full effect. Because with systems that use this method it is possible that although an acknowledgement was sent it does not arrive at the transmitter of the receiving packet, and the transmitter must thus assume that the packet it has sent was faulty. In such cases, the data packet(s) is/are unjustifiably re-sent and blocks the repeat time-slot. As with radio telecommunications systems in which data packets are transmitted by real-time critical applications and only a once-only repeat is sometimes permitted, a blockage of this kind can cause a noticeable deterioration in the performance of the system.

Advantageously, the frequencies are allocated in such a way that the radio transmitter/radio receiver calculates them itself using an algorithm. This reduces the signaling requirement and thus leads to a more effective use of resources. In addition, this approach guarantees that the allocation of all radio transmitters and radio receivers is immediately available, for example immediately during commissioning.

Advantageously, the calculation using the algorithm takes place using unambiguous identification information known to the radio telecommunications system. Such information is normally provided in every radio standard, particularly those of the new generation. Because this own information must be known to each radio transmitter/radio receiver and to the communication partners and is unique, an algorithm that is easy to implement can be used to realize an allocation.

The advantages of the method in accordance with the invention are particularly evident in a radio telecommunications system that functions in accordance with the Digital Enhanced Cordless Telecommunication (DECT) or Worldwide Digital Cordless Telecommunications (WDCT) standard, whereby an International Portable User Identity (IPUI) in accordance with DECT can then advantageously be used as identification information.

Further details and advantages of the invention are explained in more detail in a representation of an exemplary embodiment shown in Figures 1 and 2. The illustrations are as follows:

Figure 1 A scenario in accordance with a radio telecommunications system using a method in accordance with the invention,

Figure 2 The spectral representation of a subcarrier allocation in accordance with the inventive method.

Figure 1 shows a scenario with a radio telecommunications system that functions in accordance with the DECT standard. Furthermore, a radio coverage area provided by a stationary radio transmitter/radio receiver (base station) BS is shown, in which four mobile radio transmitters/radio receivers (mobile parts) MT1..MT4 are located.

The mobile parts MT1..MT4 are connected to the base station BS through an air interface defined in accordance with DECT. This is shown by the arrows. The base station BS as a central device of the radio coverage area has a switching function such that cordless communication is effected between the mobile parts shown, via the base station BS. For this purpose, the carrier

frequencies allocated to the system are divided into time slots that in turn are differentiated as time slots in the transmit direction (Tx) and time slots in the receive direction (Rx).

Figure 2 shows a framework structure resulting from this in conjunction with a method in accordance with the invention, as seen from the point of view of the base station. As the representation shows, a frame lasts a total of 10 ms. This time window of 10 ms is divided, in accordance with the example, into transmit time slots T1..T4 and receive time slots R1..R4, with the time windows being allocated to the mobile parts MT1..MT4.

In accordance with the invention, it is now provided that, if required, i.e. due to a repeat request, a repeat time-slot TX, RX is inserted, with a frequency multiplexing taking place during the duration of such repeat time slots TX, RX in such a way that data packets to be repeated are retransmitted on frequencies unambiguously allocated to the user stations BS, MT1..MT4 in the particular radio coverage area. In this case, the data packet to be transmitted is transmitted only on the particular frequency allocated to the user that requested the repeat. In this way, it is therefore on the one hand possible to serve several user stations in parallel with requested data packets and on the other hand, due to the parallel arrangement, incorrect interpretations have the effect that a lost packet acknowledgement is interpreted as a request to repeat and does not have the effect of blocking resources.

In the first time window of the frame shown, it can therefore be seen that there were no repeat requests for the transmit time slots T1..T4 of a previous time window. On the contrary, there was clearly at least one request to repeat data packets

in the time slots in the receive direction R1..R4, from which it can clearly be seen that a repeat time slot in the receive direction RX is necessary in accordance with the invention.

In the following time window it can be seen that there are clearly repeat requests both in the receive and transmit directions, because both a repeat time slot for the receive direction RX and also a repeat time slot for the transmit direction TX have been inserted in accordance with the invention (shown by the arrows).

The sequence in the event of a repeat request in the downlink direction in accordance with the invention can be summarized as follows:

If there are several repeat requests by the mobile parts MT1..MT4, the base station BS, by selection from the frequencies allocated to the mobile parts MT1..MT4 and their use, decides and distributes the requested data packets. Those mobile parts MT1..MT4 that have not requested a repeat receive nothing during the repeat time-slot on the frequencies assigned to them and therefore more or less listen into space so that they can switch off their receivers after an unsuccessful synchronization. The remaining mobile parts MT1..MT4, on the other hand, receive the required data packets on their frequencies.

The sequence in the event of a repeat request in an uplink direction is as follows:

The mobile parts MT1..MT4 that re-send due to the absence of a data packet acknowledgement, do so on the (repeat) frequencies allocated to them in accordance with the invention. The base

station BS that detects the allocation of the frequency to the mobile part has set this frequency in anticipation of the repeat requested from it, so that it also really only receives the data packet that it wanted to have. If other mobile parts also repeat data packets on the basis of the above misinterpretation, these simply run into space, so that no collisions occur.

The given exemplary embodiments represent only a few of the embodiments made possible by the invention. A person skilled in the art is able to create a variety of further embodiments by advantageous modifications, without the character (nature) of the invention, i.e. the use of frequency selection as a filter, being changed. For example, this method in accordance with the invention is also suitable for establishing a connection or the realization of a broadcast channel. These embodiments should likewise be covered by the invention.